8. QUILCENE CONSERVATION UNIT

8.1. Introduction

The Quilcene Conservation Unit includes the Big Quilcene River and Little Quilcene River watersheds as well as the Tarboo and Thorndyke Creek watersheds. Also included in this unit are the marine nearshore waters and estuaries of the Dosewallips River, Quilcene Bay, Dabob Bay, and the Toandos Peninsula to the west side of Hood Canal and north through Port Ludlow.

In the conservation unit, a supplementation program, using indigenous spawners, was implemented at the Quilcene National Fish Hatchery (QNFH) beginning in 1992 (WDFW and PNPTT 2000). The program was recognized as a strategy for preventing extirpation of the Quilcene summer chum salmon stock. The decision to initiate the supplementation program was based on three problems. Those problems were: an observed severe downward trend in wild escapement levels, the low effective population size resulting from consecutively low escapements, and the occurrence of intercepting coho-directed fisheries in the terminal areas. At the same time complementary fisheries protection actions were taken in terminal area fisheries, and habitat management actions were developed to protect the summer chum population. These actions also contributed to the decision to implement a supplementation program. Lestelle, et. al. (2005a), surmise that Quilcene is one of five extant Hood Canal summer chum salmon populations (Quilcene, Lilliwaup, Hama Hama, Duckabush, Dosewallips) that had large escapements prior to about 1980. After 1980, severe drops in abundance occurred until the mid to late 1990s, when escapement began to increase again. The consistent pattern amongst these five stocks, including Quilcene, is attributed to (from Lestelle, et. al., 2005a):

- Favorable ocean conditions for marine survival until the mid 1970s, followed by a regime shift in the ocean that was unfavorable for survival until near the turn of the century when conditions switched again to favor marine survival;
- Low harvest rates prior to the mid 1970s, followed by steadily increasing rates on Hood Canal populations, sometimes exceeding 80% and averaging close to 60% in the 1980s; harvest rates fell sharply in the mid 1990s and were at very low levels again when ocean survival conditions turned favorable;
- Hatchery supplementation fish beginning to return to the Quilcene system in 1995 and several years later to the Hama Hama and Lilliwaup systems, roughly near or corresponding to the period of improving ocean conditions and low harvest rates; although no directed supplementation has occurred in the Dosewallips or Duckabush systems, some stray hatchery fish are suspected to have entered those streams in the late 1990s.

The Quilcene is one of six core stocks that make up the Hood Canal summer chum salmon population as identified by the Puget Sound Technical Recovery Team (PSTRT) (Currens 2004 Draft in progress). Dabob Bay and Tarboo Bay are thought to provide important rearing and migratory habitat for juveniles. Bahls (2004) reports that the Tarboo-Dabob estuary has an abundance of high quality habitat for juvenile salmonids. Much of the estuary is protected as state-owned, Natural Area Preserves, including the lower mile of Tarboo Creek and its coastal spits and adjoining upland forest. Juvenile salmonids, found widely distributed throughout the estuary during sampling from February-May 2003 and again in January 2004, were thought to be summer chum and from the Quilcene natural production areas (Bahls 2004).

Current habitat conditions and situations were assessed using a variety of sources. Several sources were used to assess the summer chum salmon stocks in the Eastern Strait of Juan de Fuca conservation unit. This Salmon Recovery Plan (SRP) will not repeat the details of these assessments, but instead refers the reader to the cited documents. All material and documents referenced in this SRP should be considered part of, and integral to, the recovery of summer chum salmon. These sources provided the primary reference and knowledge base for development of these aspects of the SRP. Details of the EDT assessments for the Eastern Strait of Juan de Fuca stocks, including a summary of the baseline performance measures, and a summary of strategic priorities, are provided in Lestelle et al, (2005a) (see Appendix A). The EDT Method is a widely used tool to help prioritize habitat restoration and protection measures for salmon populations. It provides a systematic way of diagnosing habitat conditions that have contributed to the current state of populations, and it enables an assessment of priorities for developing restoration and protection plans. It also provides an analytical procedure for assessing the potential benefits to salmon populations of actions that might be taken to address habitat related issues impeding recovery. Other detailed assessments of habitat and environmental conditions are provided in the SCSCI (WDFW and PNPTT 2000), Correa (2002), and May and Peterson (2003).

May and Peterson (2003) rated the lower portions of the Big Quilcene watershed as “secondary refugia with altered ecological integrity.” The lower Little Quilcene watershed was rated as a “primary refugia with altered ecological integrity.” The Quilcene Bay, Dabob Bay, and Thorndyke Creek estuaries, and the lower Tarboo and lower Thorndyke Creeks, were rated as “priority refugia with natural ecological integrity.” These ratings suggest that, at the least a semblance of properly functioning, natural ecosystems remains. Protection and active restoration of these areas is critical for the recovery of summer chum salmon.

Priority action recommendations developed in this Salmon Recovery Plan (SRP) will focus initially on the lower 1-2 miles of river and estuarine areas. Actions in the upstream areas of the watersheds will require assessments to determine the impacts and limiting factors that contribute to degradation in the lower reaches. Protection, restoration and maintenance of the Big and Little Quilcene watersheds is of paramount importance. In both watersheds, the lower river sections (lower 1-2 miles) and the estuaries are targeted for restoration. These areas must be restored and protected to effect and ensure recovery of the Hood Canal summer chum population aggregation.

The City of Port Townsend operates a water diversion structure at river mile (RM) 9 on the Big Quilcene and has rights to 30 cubic feet per second (CFS). The diverted water is used for the City's municipal needs and to supply water to the Port Townsend Paper Company. In 1994, the City of Port Townsend agreed to reduce or halt water withdrawal during low-flow periods to maintain a minimum of 25 CFS in the channel for fish. Prior to that, an informal arrangement between the dam operators and the Quilcene National Fish Hatchery (QNFH) ensured that enough water was maintained in the river to satisfy QNFH needs. Beginning in 1998, there was a cooperative effort to monitor stream flows for spawning availability, between the City of Port Townsend, QNFH, Port Townsend Paper Co., US Fish and Wildlife Service (USFWS), Jefferson Conservation District, and the Tribes. An Instream Flow Incremental Methodolgy(IFIM) study recently conducted by WDFW does not answer whether the given low-flow of 25 CFS is sufficient to provide for good spawning habitat for summer chum. The IFIM flow recommendations were well in excess of late-summer flows in the absence of withdrawal, and are likely better applied to fall chum. Data developed by the cooperative effort will be needed to assess the impacts of stream flow on spawning habitat (WDFW and PNPTT 2000). The City of Port Townsend and the Port Townsend Paper Company have managed their withdrawals of surface water from the Big Quilcene River, in recent years, to comply with a voluntary instream flow agreement. That agreement set minimum flows at 24 CFS between 1994 and 1997, and then at 27 CFS from 1997 onward. Between 1994 and 1999, flows in the Big Quilcene River, at the diversion, have averaged 50 CFS. But, those flows have been as low as 26 CFS in the summer-chum spawning season (WRIA 17 Planning Unit 2003).

8.2. Geographic Description & Human Population Distribution

The Quilcene Conservation Unit includes all of the Big Quilcene River and Little Quilcene River watersheds as well as the Tarboo Creek and Thorndyke Creek watersheds. Also included within this unit are the marine nearshore waters starting at the mouth and estuary of the Dosewallips River and moving north to include Quilcene Bay, Dabob Bay, and along the Toandos Peninsula, along the west side of Hood Canal, and north through Port Ludlow. The marine offshore

areas of north Hood Canal, up to Admiralty Inlet, are included in this conservation unit. The majority of this conservation unit is within eastern Jefferson County with the exception of a small portion of the upper Little Quilcene River watershed that lies within Clallam County.

Figure 8.1 provides a map of the Quilcene Conservation Unit. The Quilcene watersheds cover a combined area of 98 square miles. The Little Quilcene River flows for a total mainstem length of 12.2 miles. The total length of the Big Quilcene River mainstem is 19 miles. Detailed descriptions of each of these watersheds can be found in the Summer Chum Salmon Conservation Initiative (SCSCI) Appendix 3.6 (WDFW and PNPTT 2000), the Water Resource Inventory Area (WRIA) 17 habitat limiting factors report (Correa 2002), and the WRIA 17 Watershed Management Plan (WRIA 17 Planning Unit 2003).

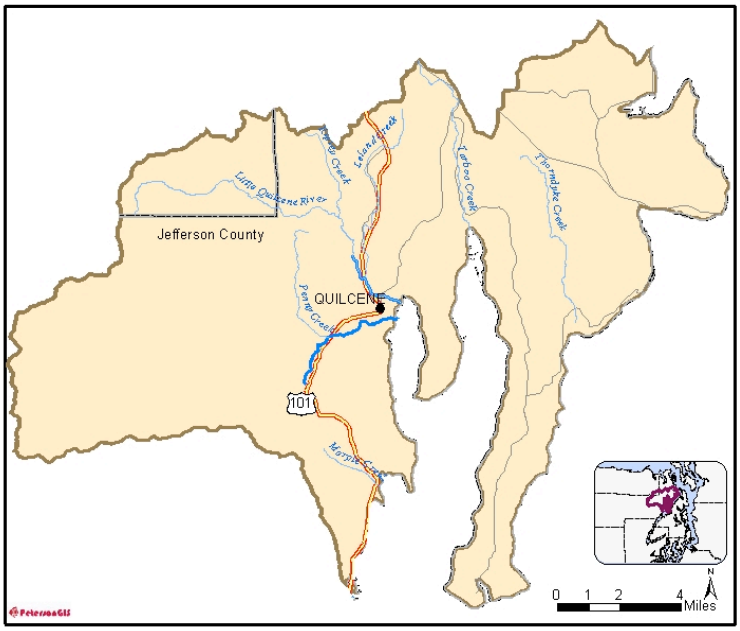

Figure 8.1. Quilcene Conservation Unit (map produced by Gretchen Peterson, Peterson GIS).

The town of Quilcene, located at the mouth of the Quilcene River, and the area around Port Ludlow, are the major concentrations of higher density human settlement in this conservation unit. Population density throughout the conservation unit is relatively low.

Figure 8.2 shows population density within the Quilcene conservation unit. Human population density, relative to summer chum salmon distribution, is low, with the possible exception of the Quilcene area (near the mouth of the Big and Little Quilcene Rivers).

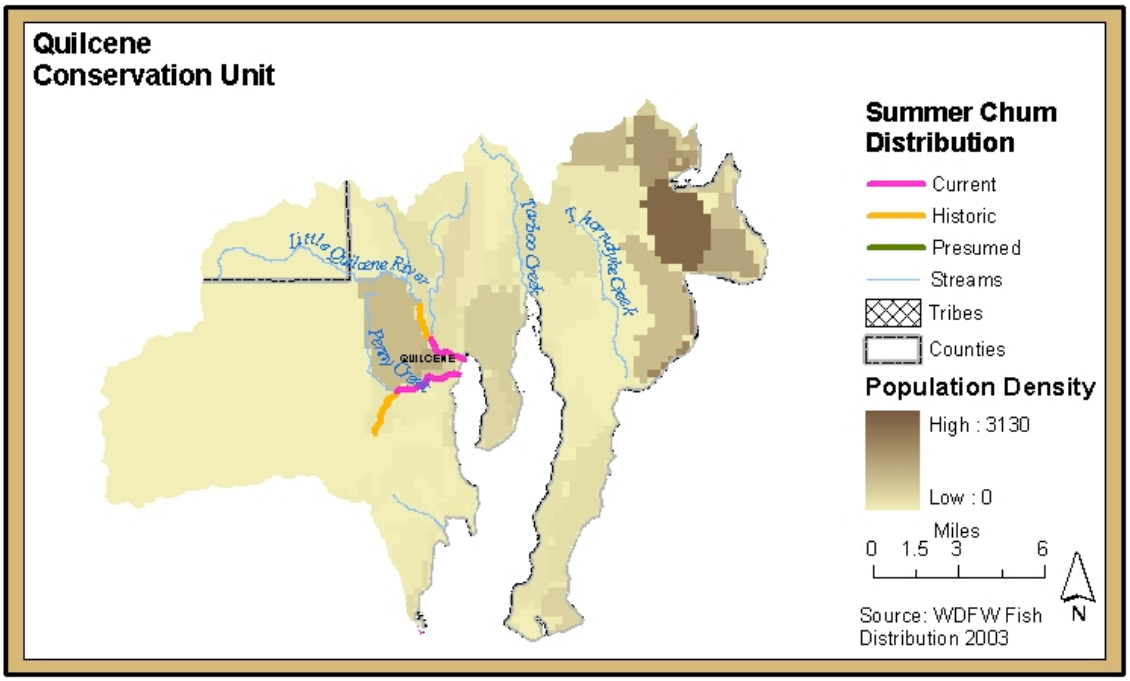

Figure 8.2. Human population density (people per square mile) for the Quilcene Conservation Unit (map produced by Gretchen Peterson, Peterson GIS).

8.3. Summer Chum Salmon Stocks' Description and Distribution

Several sources were used to assess the summer chum salmon stocks in the Quilcene conservation unit. This SRP will not repeat the details of these assessments, but instead refers the reader to the cited documents. All material and documents referenced to in this SRP should be considered part of, and integral to, the recovery of summer chum salmon. The reader is urged to review the Summer Chum Salmon Conservation Initiative (WDFW and PNPTT 2000) and subsequent supplemental reports. Summer chum salmon in Hood Canal and the Eastern Strait of Juan de Fuca were also assessed based on the application of the Ecosystem Diagnostic and Treatment (EDT) Method (see Appendices A and B). The EDT Method is a widely used tool to assist in the prioritization of habitat restoration and protection measures for salmon populations. EDT provides a systematic way of diagnosing habitat conditions that have contributed to the current state of fish populations. It enables an assessment of priorities for developing restoration and protection plans. It also provides an analytical procedure for assessing the potential benefits of actions that might be taken to address salmon habitat problems (Lestelle, et. al., 2005a).

The complete detailed EDT for summer chum salmon can be found at http://www.wa.gov/hccc/ and click on the Salmon Recovery Planning Activities link. On that page can be found links to various documents and the EDT web site for summer chum salmon. The web address for the EDT site: www.mobrand.com/edt/sponsors/show_sponsor.jsp?sponsor_id=11

8.3.1. Stocks' Status & Trends

Naturally produced summer chum salmon originating from the Quilcene Conservation Unit are likely from the Big and Little Quilcene watersheds (WDFW and PNPTT 2000). Summer chum spawn in the mainstem of the Big Quilcene up to RM 2.8, where the QNFH weir prevents further upstream access. Historically, summer chum may have spawned as far up as RM 5. Most spawning occurs below RM 1. Spawning in the Little Quilcene River stretches in the mainstem up to RM 3, with the majority spawning below RM 1.8. Current, historic and presumed summer chum salmon distribution in the Quilcene Conservation Unit is shown in Figure 8.3.

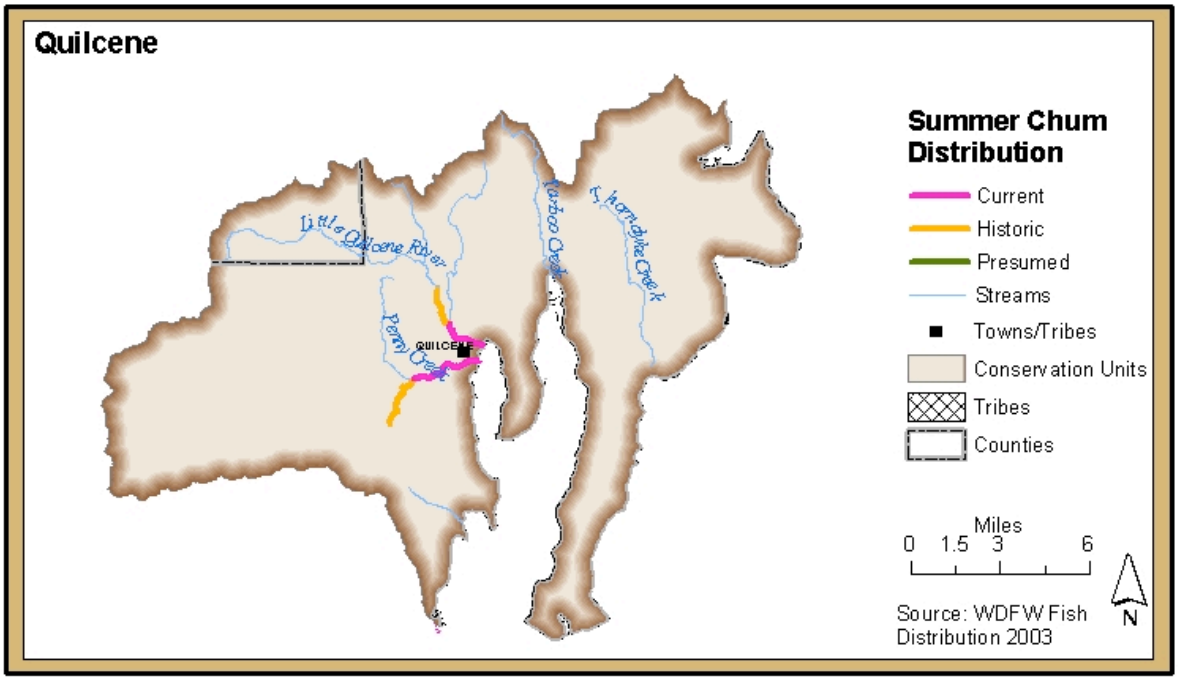

Figure 8.3. Map of the Quilcene Conservation Unit showing current, historic and presumed summer chum salmon distribution.

Summer chum salmon produced from both the Big Quilcene and Little Quilcene Rivers are part of the Hood Canal population targeted for recovery by the PSTRT. The Hood Canal population is one of two independent summer chum populations tentatively identified by the PSTRT (Currens 2004 Draft in progress).

Currens (2004 Draft in progress) provides a detailed analysis of these conclusions. It speculates on the importance of the historical geographic distribution of summer chum salmon habitat and the overall "isolation-by-distance relationship" that seems to be observed in the summer chum salmon aggregations. More analyses of population identification and viability are expected from the PSTRT. At this time it is not expected that these analyses will affect the basic approach taken for recovery in this SRP.

PNPTT and WDFW (2003) have identified as one stock the summer chum salmon that naturally produce in the Big Quilcene and Little Quilcene Rivers to to be targeted for recovery in the Quilcene Conservation Unit. The Quilcene stock is one of the six stocks that comprise the PSTRT designated Hood Canal aggregation. The co-manager interim recovery goals for this stock are presented in Table 8.1.

Table 8.1. Hood Canal aggregation: co-manager interim abundance and escapement recovery goals for the Quilcene spawning aggregation.

Stocks	Abundance	Escapement
Quilcene	4,570	2,860

Abundance is defined here as the size of the run or the number of recruits. Recruits are the number of fish (in this case summer chum salmon from the Hood Canal/Eastern Strait of Juan de Fuca ESU geographic area) available for all fisheries in any given year. Escapement is defined as the number of adults that return to the natal spawning grounds (they escaped all fisheries and are available to spawn). PNPTT and WDFW (2003) also developed abundance and spawning escapement threshold criteria. One of the criterion for recovery is that a summer chum stock (Quilcene) must, over a minimum of the most recent twelve year period, have both a mean abundance, and mean escapement, of natural-origin recruits, that meets or exceeds the defined thresholds. Table 8.2 provides a summary of escapement for the recent twelve year period, 1993-2004, for the Quilcene spawning aggregation.

Table 8.2. Escapement threshold for the Quilcene spawning aggregation based on PNPTT and WDFW (2003).

	ESCAPEMENT				
Population aggregation	**93-04 Average**	**Target**	**% of target**	**# times below target 2001-2004 (≤1)**	**# times below target 1997-2004 (≤2)**
Quilcene	8059	2860	282	0	0

The Quilcene aggregation currently exceeds the escapement threshold as established by the co-managers. But this population is likely a combination of

both hatchery and natural-origin recruits, and to meet the recovery goal 12-year criterion, only natural origin must be counted. The PNPTT, WDFW and USFWS initiated a 12-year brood stocking and supplementation program beginning in 1992 (WDFW and PNPTT 2000). The broodstocking program for the Quilcene River ended with the 2004 return year. Broodstock from the Quilcene population was used to reintroduce summer chum salmon back into Big Beef Creek during the 1996 and 1997 seasons.

Additional co-manager criteria require that the stocks do not fall below the target more than once in the recent four-year period and no more than twice in the recent eight-year period. The Quilcene aggregation does meet the criteria for the recent four-year period and for the recent eight-year period. It should also be noted that criteria for productivity (for example, eight year average equal to or greater than 1.6 recruits per spawner) must be met for recovery. Data currently are insufficient to assess the productivity criteria but are being collected (PNPTT and WDFW 2003).

Summer chum salmon escapement (number of adults returning to spawn) for the Quilcene Conservation Unit (combination of Big Quilcene and Little Quilcene) from the years 1974-2004 is presented in Figure 8.4.

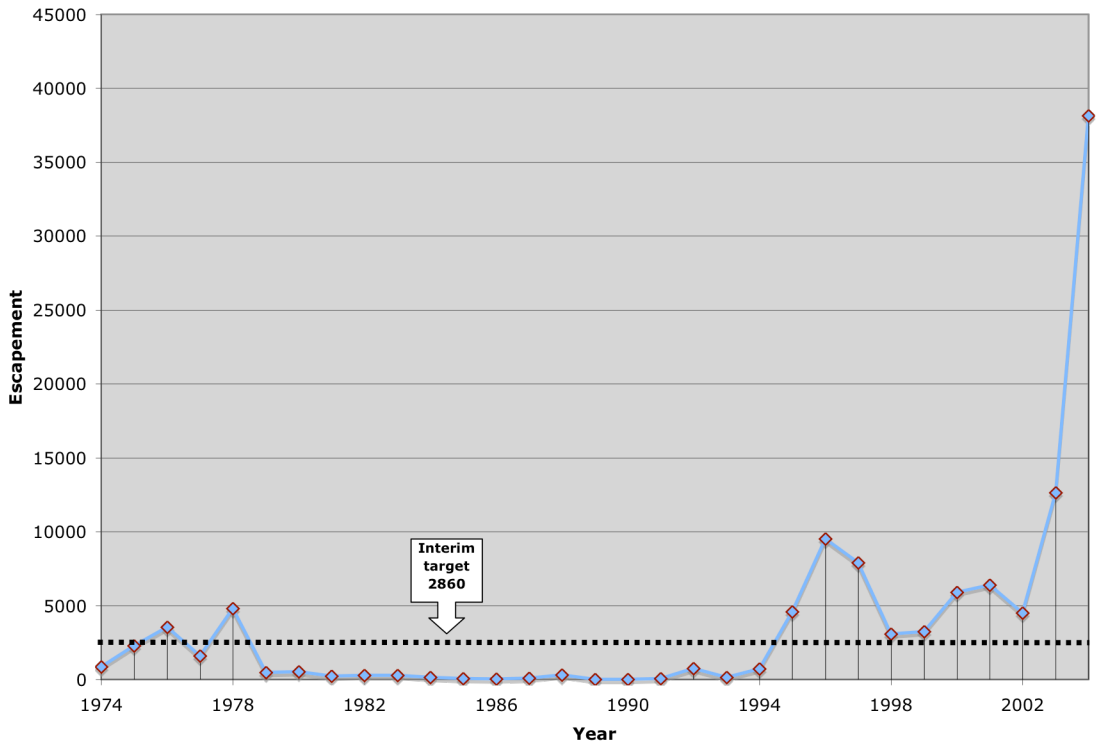

Figure 8.4. 1974-2004 summer chum salmon escapement for the Quilcene Conservation Unit, combined total for both the Big Quilcene and Little Quilcene Rivers (data source: WDFW and PNPTT 2003, 2004, and 2005).

The co-managers have assessed the extinction risk faced by individual summer chum salmon stocks, based on the methodology offered by Allendorf, et. al. (1997), and discussed in detail in section 1.7.4 of the SCSCI (WDFW and PNPTT 2000). The extinction risk was assessed again in 2003, based on data available through 2002 (WDFW and PNPTT 2003). A more recent assessment of extinction risk from the co-managers for the Quilcene stock stated, "Escapement estimates averaged 4,999 summer chum spawners (range of 3,237 to 6,373) for the Big/Little Quilcene summer chum stock for the 1999 through 2002 return years. The combined (including broodstock removals) total effective population size (Ne) equals 3,599 fish for the 1999-02 return years, and the total population size (N) is 17,996 for the same years. These recent returns likely were affected by the existing supplementation project begun in 1992. Based on a stable escapement trend and the large recent escapements, the current extinction risk for this stock is low."[41]

8.4. Habitat Overview and Environmental Conditions

Details of the EDT assessments for the Quilcene stock, including a summary of the baseline performance measures and a summary of strategic priorities, are provided in Lestelle, et. al. 2005 (see Appendix A). Other detailed assessments of habitat and environmental conditions are provided in the SCSCI (WDFW and PNPTT 2000), Correa (2002), and May and Peterson (2003).

8.4.1. Factors contributing to the decline of summer chum salmon

The Quilcene population shows a severe loss in performance, particularly in productivity. Under sustained, unfavorable, ocean conditions, the population would be at a high risk of extinction (Lestelle, et. al. 2005a).

In summary the EDT Conclusions for Quilcene (Lestelle et al 2005a) say that:

- The Quilcene population shows a high loss in performance compared to historic levels both in abundance and productivity, particularly under unfavorable ocean survival conditions.
- The amount of potential increase in population abundance is greatest through restoration of freshwater reaches; full restoration of estuarine-

[41] This assessment has just been updated by the co-managers and includes the years 2003 and 2004 (WDFW and PNPTT In preparation). The update indicates no change in the judgement of a low extinction risk.

marine waters offers a somewhat higher potential benefit than would occur for the natal subestuary. Restoration of the Big and Little Quilcene rivers offers similar levels of benefit.

- Protection of freshwater reaches shows the highest priority.
- Potential benefits of restoring estuarine-marine areas are diffused over many segments, but the Dabob Bay shore is ranked highest among these areas, followed by the Oak Bay segment. The reason for the high value of the Dabob Bay shore is due to its amount of change that has occurred in conjunction with its proximity to the Quilcene River. The reason for the high value of the Oak Bay segment is less clear. We believe this to be partly the result of how we expect migration to proceed. Fish from both shores of Hood Canal concentrate on the west side of Admiralty Inlet as they move to the Strait. The importance of the Oak Bay area is also partly due to the increasing amount of competition with hatchery fish, as summer chum move through Admiralty Inlet (being joined by fish from other areas in Puget Sound).
- Within freshwater, habitat diversity, channel stability, flow, and sediment load are seen as the most important factors to restore.
- Within the natal subestuary, food, and habitat diversity, appear to be equally important for restoration, along with the amount of area available for rearing.
- Within the estuarine-marine environment, the most important factor for restoration is food, associated with loss of eelgrass, shoreline development, and loss of riparian corridors.

The SCSCI (WDFW and PNPTT 2000), the "Limiting Factors Report for WRIA 17" prepared by the Washington Conservation Commission (Correa 2002), and May and Peterson (2003) provide details of the various habitat factors and environmental conditions affecting summer chum salmon in this conservation unit. In general, the findings from these reports are corroborated by the EDT assessment (see Appendices A and B). These factors and conditions are summarized in the tables below for Little Quilcene River (Table 8.3) and the Big Quilcene River (Table 8.4).

Table 8.3. Little Quilcene River

Factors for decline	Life stage most affected	Remarks
Low flow	Spawning	Mean annual flow is approximately 54 CFS with low flows of 5 to 13 CFS. Further assessment of the low flow situation is necessary to determine appropriate response and actions to ensure access for spawning.
Loss of channel complexity (LWD, channel condition, loss of side channel, channel instability)	Spawning and incubation	In lower reaches, channel habitat is highly degraded with 32% of the area as pools, 0.1 pieces of LWD/m and an average of 5.3 channel widths between pools, LWD removal occurs and the banks are hardened with riprap in places.
Sediment aggradation	Spawning and incubation	Channelized and diked area in the lower reaches has resulted in channel aggradation and avulsions leaving the main channel dry for several weeks
Loss of riparian forest	Spawning and incubation	70% of the forested buffer area consists of small trees (<12 in dbh), 51% is deciduous dominated with no riparian forest, 66% of the riparian area is <66 ft in width leaving the riparian area highly degraded from historic conditions
Estuarine habitat loss and degradation (diking, filling, log storage, road causeways)	Juvenile rearing and migration	Estimated that 25% of the historic delta area (230 ac) is now diked. Road or causeway segments, totaling close to 0.5 miles in lineal extent, may constrict or prevent natural tidal inundation of adjoining wetlands.

Table 8.4. Big Quilcene River

Factors for decline	Life stage most affected	Remarks
Loss of channel complexity (LWD, channel condition, loss of side channel, channel instability) and floodplain loss	Spawning and incubation	Historically (late 1950's) the channel was a narrow meandering single thread with good levels of LWD, pools and an intact riparian forest. Now it is wide, braided and in poor condition. No pool habitat in the lower 1.0 mile; so it is essentially one long riffle. Bank armoring, dredging, and dike construction has exacerbated flooding and channel scour.

Sediment aggradation	Spawning and incubation	Channelized and diked area in the lower reaches has resulted in channel aggradation. Forest Service logging roads built during the 1940's to 1960's contribute to the sediment problems.
Loss of riparian forest	Spawning and incubation	44% of the forested buffer area consists of small trees (<12 in dbh), 49% is deciduous dominated with no riparian forest, 45% of the riparian area is <66 ft in width leaving the riparian area highly degraded compared with historic conditions. Future LWD recruitment is considered from poor to moderate.

Estuarine habitat loss and degradation (diking, filling, log storage, road causeways)	Juvenile rearing and migration	Estimated that 21% of the historic delta area (125 ac) is now diked. The dikes prohibit access to sloughs and side channels on the lower river and estuary. About 3% of the historic delta is now filled. Over the past 100 years the river mouth has been extended about 1,700 feet out into the bay due to dredging and diking. A very high density of roads (7.2 miles/square mile of watershed) occurs in the lower river.

8.4.2. Human development and land use

Population density in the Quilcene Conservation Unit is relatively low. Figure 8.5 Presents population density for the Quilcene conservation unit.

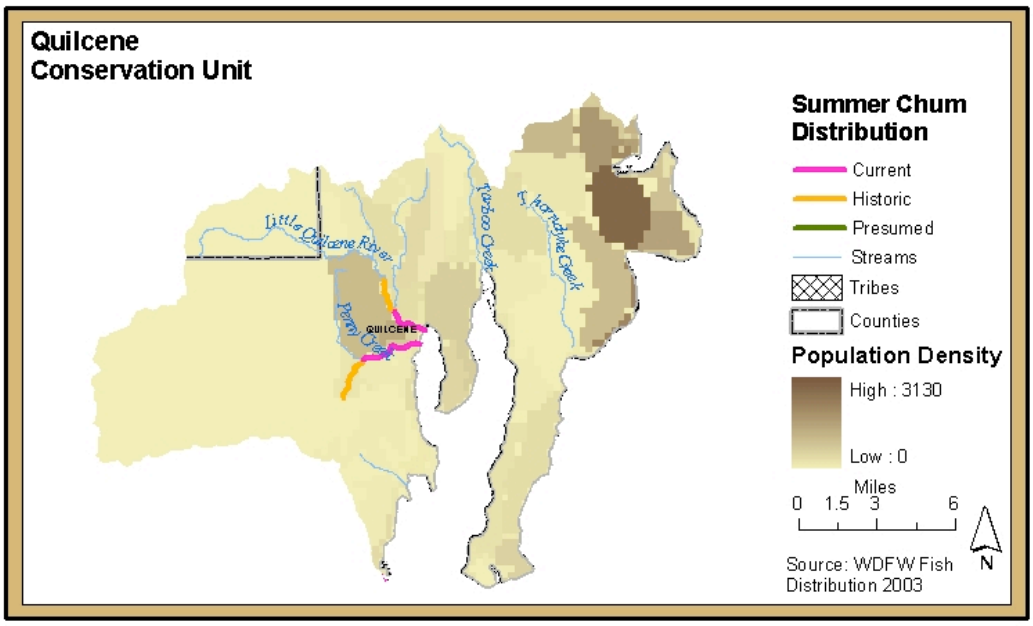

Figure 8.5. Human population density (people per square mile) for the Quilcene River conservation unit (map produced by Gretchen Peterson, Peterson GIS).

The highest density of human population currently exhibited in this conservation unit can be fund in the Port Ludlow area. Densities in the Quilcene watersheds are low to moderate, with the higher density of human population concentrated near the river mouths at the head of Quilcene Bay.

Christensen 2005 reports that an additional 179 people are expected over the next twenty years in the Big Quilcene and Little Quilcene watersheds combined. Table 8.5 presents the results of population projections and growth rates.

Table 8.5. Population projections and growth rates for the Quilcene watersheds (from Christensen 2005).

Watershed	Human Population in 2000	20 Year Estimated Human Population Growth	2024 Estimated Human Population	Notes
Little Quilcene River	353	69	422	Rural Growth Rate assumed 1.09%
Big Quilcene River	560	110	671	Rural Growth Rate assumed 1.09%

Jefferson County zoning indicates that 93 percent of the Big Quilcene watershed is in forestry (86% of which is within the Olympic National Forest with multiple use placing some acreage in wilderness areas), 4 percent is in rural residential

categories, 0.2% in agriculture and 0.1% in commercial use. The lower portions of both the Big Quilcene River and the Little Quilcene River flow through areas with land use coded by Jefferson County as Rural Residential (RR 1:5, RR1:10 or RR 1:20), Agricultural Resource Lands (AP 1:20 or AL 1:20), and Commercial Forest. Figure 8.6 provides the zoning delineations for the lower Quilcene watersheds. This map and the rest of Jefferson County's zoning can be found at (http://www.co.jefferson.wa.us/idms/mapserver.shtml).

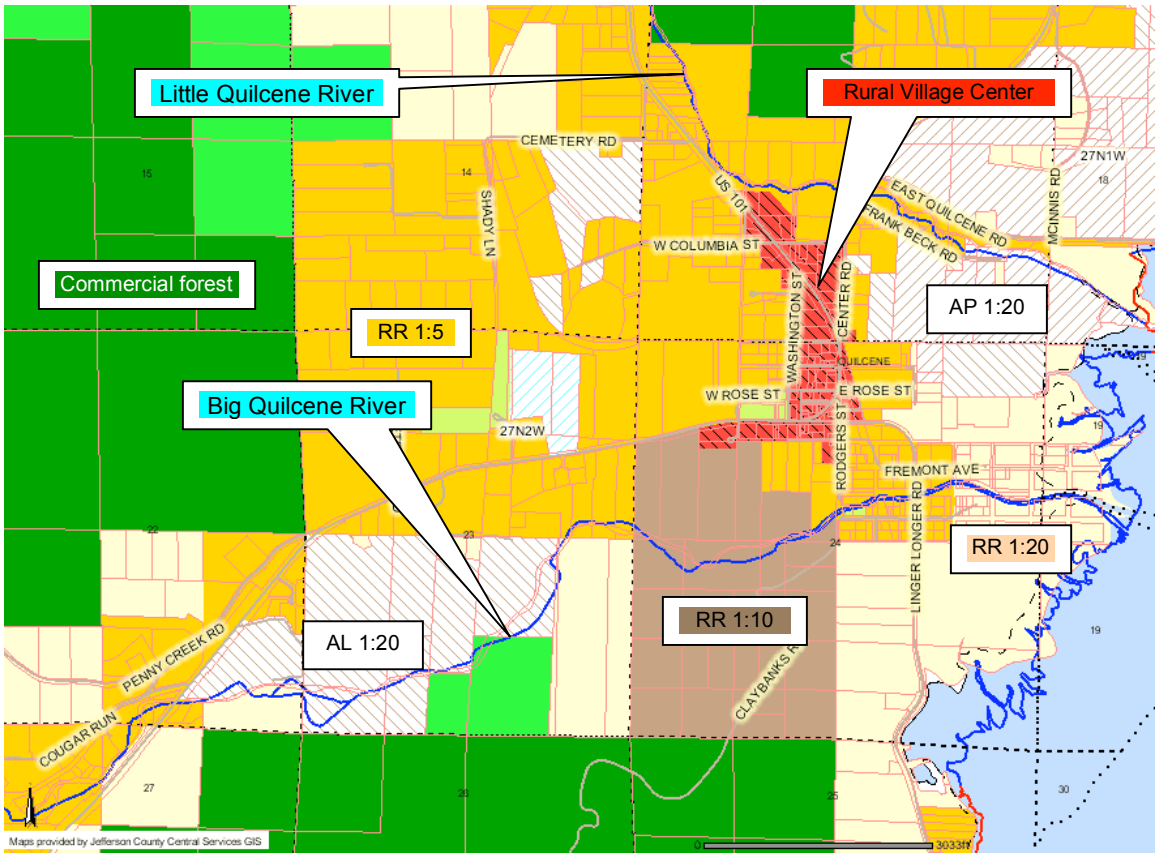

Figure 8.6. Zoning for the lower portions of the Big and Little Quilcene watersheds. (http://www.co.jefferson.wa.us/idms/mapserver.shtml)

The unincorporated town of Quilcene sits at the mouth of these rivers where it is zoned as a Rural Village Center (RVC). According to Jefferson County Unified Development Code, Title 18, Rural Village Centers "provide for most of the essential needs of the surrounding rural population and the traveling public. These areas supply a variety of basic goods and day-to-day services, while also providing a limited range of professional, public and social services. They are typically small, unincorporated commercial and residential community centers that provide rural levels of service and serve as a focal point for the local population. The boundaries of the rural village centers are predominantly defined

by the contained, built environment as it existed in 1990 or before, as required by RCW 36.70A.070(5)(d)." Designated rural village centers for Jefferson County include Quilcene and Brinnon. Rural Residential 1 Unit/5 Acres (RR 1:5) areas "allow for continued residential development in areas of Jefferson County consisting of relatively high density pre-existing patterns of development, along the county's coastal areas, and within areas within or adjacent to rural centers and rural crossroads. In addition, this district seeks to support and foster Jefferson County's existing rural residential landscape and character by restricting new land divisions to a base density of one unit per five acres." Rural Residential 1 Unit/10 Acres (RR 1:10) areas "provide a transitional area between the rural residential one per five acre district and the rural residential one unit per 20 acre district. Its intent is to preserve open space, protect critical areas, provide for the continuation of small-scale agricultural and forestry, and preserve and retain the rural landscape and character indigenous to Jefferson County.

Prime Agricultural Lands (AP-20) are designed to protect and preserve areas of prime agricultural soils for the continued production of commercial crops, livestock, or other agricultural products requiring relatively large tracts of agricultural land. It is intended to preserve and protect the land environment, economy and lifestyle of agriculture in Jefferson County. These lands must be protected as "agricultural lands of long-term commercial significance." Agricultural Lands of Local Importance (AL-20) are designed "to protect and preserve parcels of land which, while not necessarily consisting of prime agriculture soil or relatively large acreage, are still considered important to the local agricultural economy, lifestyle and environment." As such these lands deserve protection as "agricultural lands of long-term commercial significance."

Commercial Forest (CF-80) lands are designated to "ensure large tracts of forest lands of long-term significance are protected from incompatible uses thereby sustaining the ability of forest resource extraction activities to be maintained as a viable commercial activity."

The current upper extent of summer chum salmon distribution on the Big Quilcene River ends at the Quilcene National Fish Hatchery operated by USFWS. The Quilcene National Fish Hatchery, located at river mile 2.8, uses water from both the Big Quilcene and from nearby Penny Creek. Upstream passage is restricted on the Big Quilcene between September and December by an electric weir operated by the fish hatchery. A raised culvert and water intake structure permanently block access to Penny Creek, which has been identified as excellent refugia habitat (Correa 2002). The upper Quilcene watersheds flow out of a combination of Federal, State and commercial forest lands. The primary water source for the City of Port Townsend (30 CFS water-right) is diverted at river mile 9.4 on the Big Quilcene River.

The upper watershed of the Little Quilcene River is managed for public and private commercial forestry. A total of 52 percent of the watershed is zoned forestry, 17 percent rural residential and 0.8 percent agriculture. Sixty percent of the riparian zone below river mile 3 is developed with agriculture, roads/dikes, rural residences and forestry. The lower 0.8 miles contains dikes and bank armoring for residences in the floodplain. Dikes, roads and ditches impact the tidal delta. The City of Port Townsend diverts water (9.6 CFS water-right at the diversion, with a 6 CFS minimum instream flow requirement) on the Little Quilcene River, at river mile 7.1, to Lords Lake Reservoir on Howe Creek, which is removed from the watershed (Correa 2002).

Figure 8.7 shows the Jefferson County land use zoning for the Little Quilcene watersheds.

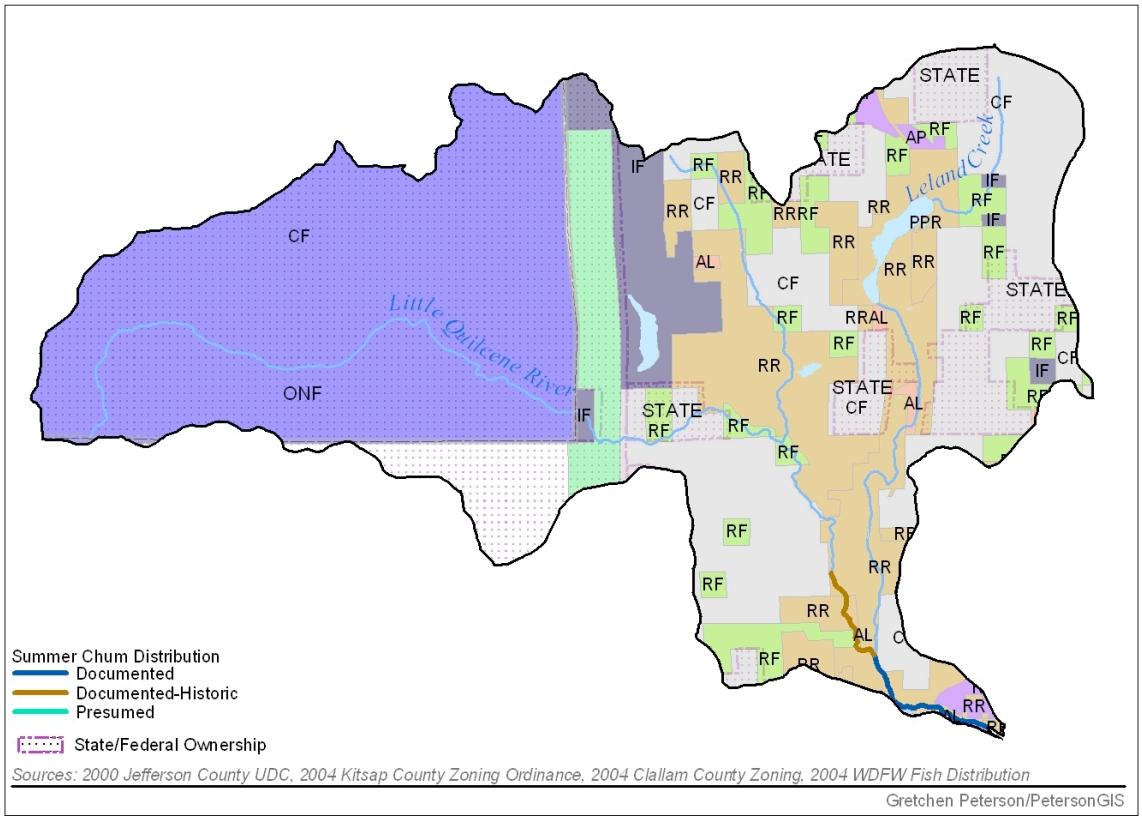

Figure 8.7. Jefferson County zoning for the Little Quilcene watershed.

Figure 8.8 presents Jefferson County zoning for the Big Quilcene watershed.

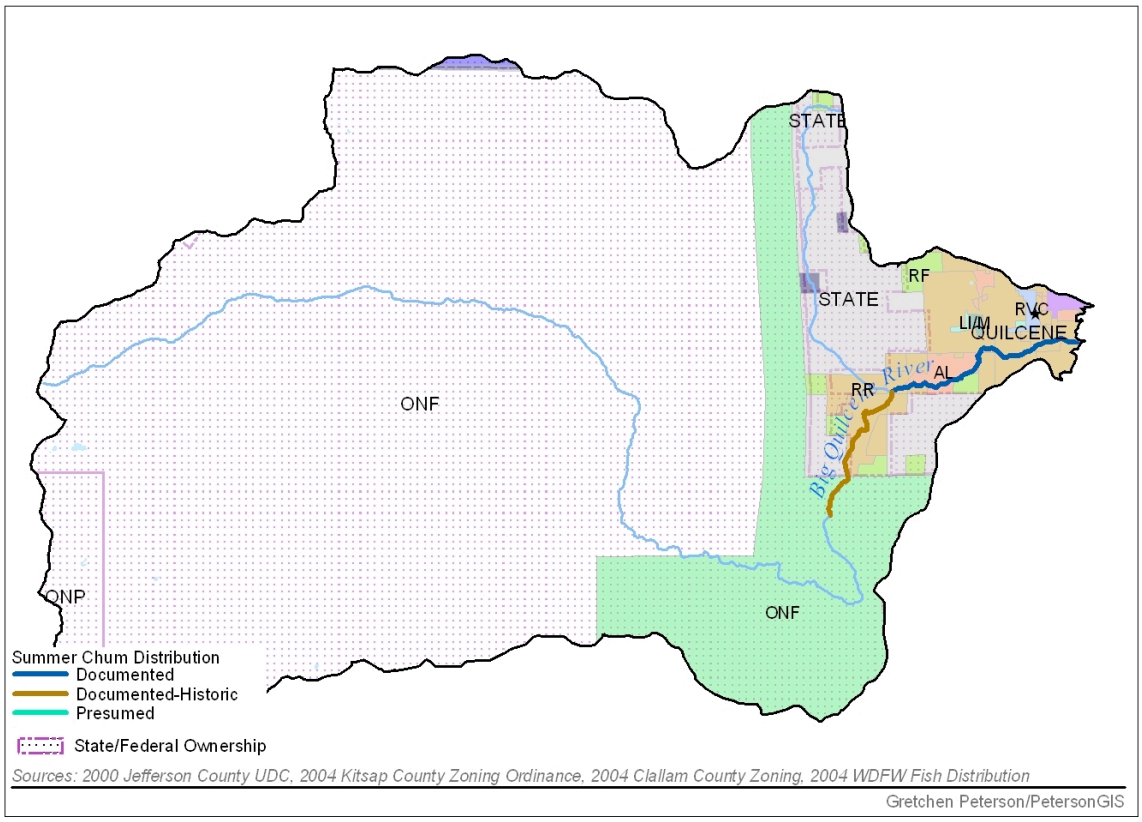

Figure 8.8. Jefferson County zoning for the Big Quilcene watershed.

Understanding future population growth, and its associated development, is critical to determine the potential future impacts to summer chum salmon habitat. A build-out analysis was conducted for the summer chum salmon ESU geographic area. This analysis used impervious surface area as a proxy for development. Based on existing land use designations (which are unique to each individual County), future impervious surface area was calculated and modeled. The amount of additional impervious surface area (relative to current) and where it can be expected to occur was determined for each County. Appendix C provides details of the methods used to conduct these build-out analyses.

Current and projected development in the Quilcene watersheds was analyzed (Peterson 2005 see Appendix C). Riparian corridors were delineated from 200 feet on either side of the river from the mouth upstream to the extent of presumed summer chum salmon distribution. Impervious surface area (IP) was measured using 5-meter resolution satellite imagery. Current IP within the Big Quilcene riparian corridor is 4.2% of the total riparian corridor area. For the Little Quilcene corridor, this value is 8.7%. Build-out looked at the potential to develop

the land under current regulatory programs and land use. Build-out for the Big Quilcene corridor is projected at 7.0% of the total area or an additional 6.6 acres of IP. For the Little Quilcene corridor, the additional acres of IP under build-out are projected to be 3.8, for a total of 11.6% of the corridor. These results are summarized in Table 8.6.

Table 8.6. Current impervious area (IP) and modeled build-out for the Big Quilcene and Little Quilcene riparian corridors.

Riparian Corridor	Corridor area acres	Current IP acres	Build-out IP acres	Added IP acres	Current IP%	Build-out IP%
Big Quilcene River	236	9.8	16.4	6.6	4.2	7.0
Little Quilcene River	130	11.3	15.1	3.8	8.7	11.6

The uplands, and nearshore within one mile of the Quilcene subestuaries, were also analyzed for projected build-out (Peterson 2005). Due to the close proximity of the mouths of both rivers, the estuary build-out analysis combined them. Of the total area delineated in the subestuary zone, current IP is at 1.6%. After build-out the IP climbs to 2.9%, for a total of 12.1 additional acres within the delineated subestuarine zone. The results of this analysis are summarized in Table 8.7.

Table 8.7. Current impervious area (IP) and modeled build-out for the subestuaries of the Big and Little Quilcene Rivers.

Estuary	Estuary Acres	Current IP acres	Build-out IP acres	Added IP acres	Current IP%	Build-out IP%
Quilcene	871	17.7	29.8	12.1	1.6	2.9

Watershed and stream research, which typically looks at a watershed-wide perspective, generally indicates that certain zones of stream quality exist. Most notably, at about 10% impervious cover area, sensitive stream elements are lost from the system. A second threshold appears to exist at around 25 to 30% impervious area, where most indicators of stream quality consistently shift to a poor condition (e.g., diminished aquatic diversity, water quality, and habitat scores).[42] More research is needed to determine if this research directly applies

[42] See The Center for Watershed Protection's (http://www.cwp.org) Stormwater Manager Resource Center at http://www.stormwatercenter.net for more extensive references on this subject. Table 1 at http://www.stormwatercenter.net/monitoring and assessment/imp cover/impercovr model.htm reviews the key findings of recent research regarding the impacts of urbanization on aquatic systems.

to the present analysis. It should be noted that similar research, however, has not been conducted for estuary and subestuary areas.

8.5. Specific Action Recommendations

This section presents specific recovery action recommendations for the Quilcene conservation unit. Recommended actions are categorized as either Programmatic (section 8.5.1) or Project (section 8.5.2). Actions identified will be further delineated as actions to benefit the targeted spawning aggregation (Quilcene). Specific action recommendations are also summarized and analyzed in the context of overall ESU-wide recovery (see section 13). All actions (previously implemented, on-going, and proposed) will become part of the Monitoring and Adaptive Management Program for the SRP as described in section 14.

8.5.1. Programmatic Actions

Programmatic recovery actions are those that are part of a policy, program, or process. They are generally of a regulatory or planning process nature. Programmatic actions could be part of a County's land use and regulatory program and structures, or watershed planning processes. Comprehensive plans, critical areas ordinances, shoreline management master programs, and zoning could all be considered programmatic actions in this context. Programmatic actions are non-project (i.e., habitat restoration projects--LWD placement, culvert repairs, etc.) in nature. Programmatic actions, however, can include projects when such projects are descriptive of a comprehensive or encompassing process (i.e., levee removal or set back as part of an estuary restoration plan). Watershed management plans often include projects to address identified factors of decline or specific habitat conditions. For the purposes of this SRP, the management plans or planning processes will be considered programmatic actions whereas the projects identified within the management plans will be categorized as projects.

To most effectively address those factors that are likely affecting the performance of the Quilcene spawning aggregation, the SRP recommends the following programmatic actions summarized in Table 8.8. Details of the programmatic actions approved and those being considered by the Jefferson Board of County Commissioners can be found in section 13.

Table 8.8. SRP recommended programmatic actions for the Quilcene spawning aggregation.

Recommended Programmatic Actions	Actions involved	Limiting factors to address
Jefferson County zoning for the Quilcene watersheds	-support continuation of the present zoning for the upper watersheds -monitor long-term effectiveness of the zoning code and enforcement -support Staff on their efforts regarding the core habitats and corridors work including development within channel migration zones -adopt CMZ guidelines as proposed for the CAO update (see section 13- "Jefferson County Programmatic Actions" for more details)	- poor riparian condition - loss of channel complexity (LWD, channel condition, loss of side channel, channel instability)
Tri-Area UGA Stormwater Management Plan	-implement provisions of the Stormwater Management Plan -consider adoption of a stormwater control to assist in the implementation of the key provisions	- poor riparian condition - loss of channel complexity (LWD, channel condition, loss of side channel, channel instability)
City of Port Townsend water supply	-support the recommendations of the WRIA 17 (WRIA 17 2003) watershed planning process regarding this issue -support City of Port Townsend's efforts and agreement to continue to ensure adequate spawning flow remains in the lower Big Quilcene during the months of August and September -consider formalization of the agreement to ensure adequacy in perpetuity	-low flow -inadequate future flows for spawning and outmigration
Olympic National Forest and State lands	-continue to preserve these lands in current ownership -Forest Service road maintenance and road abandonment plans should be implemented including appropriate resources to effectively complete the projects	-sediment aggradation
Community Nearshore Restoration Program	-pursue application and implementation of a Community Nearshore Restoration program similar to that being conducted in south Hood Canal (see section 13)	-estuarine and nearshore habitat loss and degradation

Quilcene River Summer Chum Salmon Supplementation Project	-ensure appropriate and properly funding monitoring occurs. -see section 14 of this SRP	-see WDFW and PNPTT (2000) and (2003a) for complete details of this project, also section 5 of this SRP

8.5.2. Projects

Project recovery actions are generally physical modifications to the landscape designed to address specific habitat situations in specific and limited geographic areas. Projects in the summer chum salmon ESU have been in progress for many years by a variety of groups and entities. Section 8.5.2.1 provides an overview of existing projects relative to summer chum salmon recovery planning. Many of the project recommendations presented in this SRP are from the HCCC Lead Entity strategy (HCCC 2004). This SRP is designed to coordinate with and build on that strategy. All projects that are proposed or recommended in this SRP are strictly voluntary in nature. Those projects that would either take place on, or impact, private property will require the full cooperation and permission from the affected landowners before proceeding. If that landowner permission cannot be obtained, those projects will not proceed. Estimated costs for these projects are presented in Appendix D.

8.5.3. Existing projects

Figure 8.7 provides a map of existing projects within the Quilcene conservation unit.

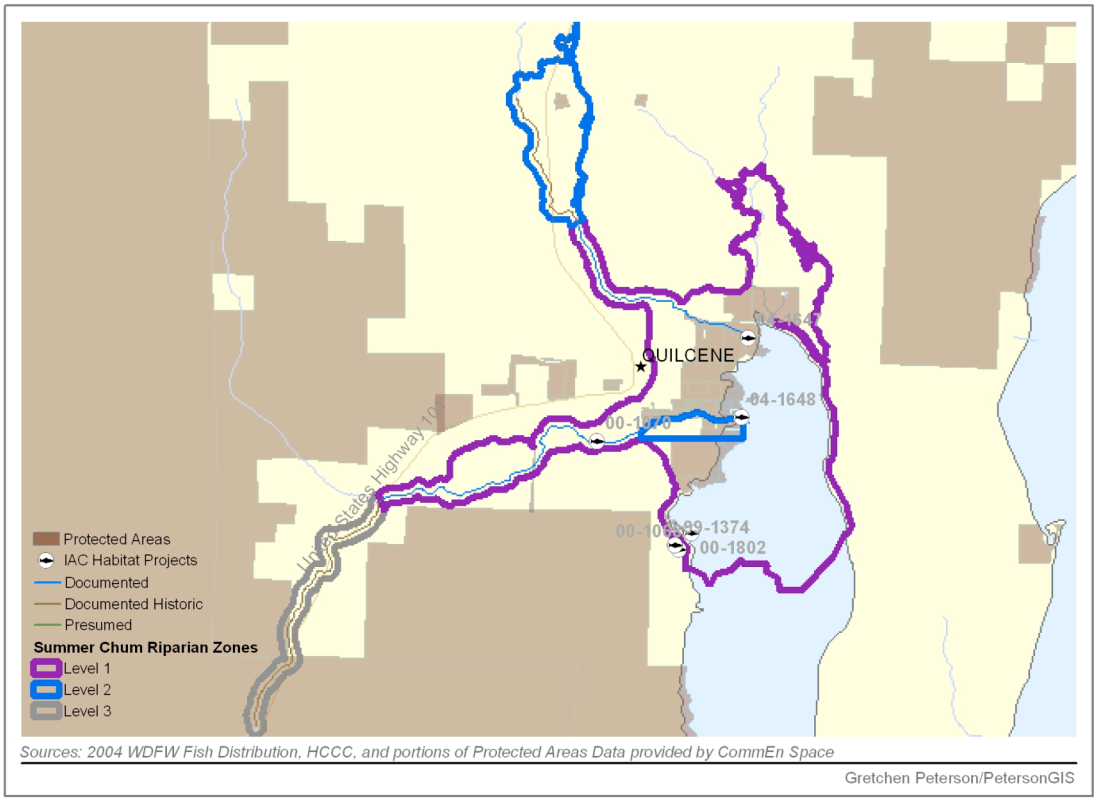

Figure 8.7. Existing summer chum salmon recovery projects located in the lower Quilcene watershed. Shaded areas represent protected lands.

Two of the existing and completed projects are described below (project descriptions are derived from IAC Grant Projects at http://www.iac.wa.gov/maps/default.asp and click on the Grant Project Maps link, accessed on June 14, 2005):

99-1374 Indian George Railroad Bridge Project Description:
This project is phase 1 of a 2-phase estuary restoration project. Phase 1 reconnected 2 slough segments in Quilcene Bay with a 60' Railroad Flat Car Bridge, connected Indian George Creek to the slough, and added scour logs to the lower creek to decrease water velocity. Reconnection of the 2 slough segments, removal of accumulated sediments, and the addition of slough-to-creek access will increase the quality and quantity of estuarine rearing habitat & remove an existing salmonid migration barrier. The southerly slough was cut off from a northerly slough by sediment aggradation caused by a failing culvert, which is also a fish barrier. This affects coho, steelhead, chum, and cutthroat migrating between the creek and the estuary. The culvert was removed and replaced with a 60' RR car bridge reconnecting both slough areas and the creek. This action will restore the southern slough habitat functions & increase the

quantity of rearing habitat and will increase salmonid access to a 10-acre tidal area, restoring circulation, nutrient distribution, and reduce water temperatures in the slough & nearshore area.

00-1802 Indian George Creek Estuary Restoration Project Description: Indian George Creek flows into the west side of Quilcene Bay, one mile south of the mouth of the Big Quilcene River. The 1.7 mile long stream was once associated with a significant estuary, 7 - 8 acres in size. Nearly 50 years ago the stream was channelized directly into Quilcene Bay and access roads were constructed across the upper part of the estuary and its outlet, which disconnected the stream from its estuary. The goal of the project was to restore estuary function and values by eliminating 250 lineal feet of parking lot fill and removing three derelict barges to restore the tidal prism and estuary habitat. This allows wave energy full access to the estuary to remobilize sediments from the fluvial into the marine system. Properly functioning estuaries have long been recognized as very productive aquatic environments. Summer chum and cutthroat also inhabit this system. The Hood Canal Salmon Enhancement Group is partnering with the WDFW to design, construct and manage this important project. Previously, the Jefferson Conservation District, Wild Olympic Salmon, and the Quilcene-Snow Restoration Team completed phase 1, the upstream habitat restoration portion.

8.5.3.1. Project recommendations

To most effectively address those factors that are likely affecting the performance of the Quilcene spawning aggregation, the SRP recommends the following projects for the Big Quilcene watershed (Table 8.10), the Little Quilcene watershed (Table 8.11) and Quilcene-Dabob Bay (Table 8.12). All projects that are proposed or recommended in this SRP are strictly voluntary in nature. Those projects that would either take place on, or impact, private property will require the full cooperation and permission from the affected landowners before proceeding. If that landowner permission cannot be obtained, those projects will not proceed.

Table 8.10. Big Quilcene River

Recommended Projects/Actions	Tasks involved, sub-actions, barriers to implementation	Limiting factors to address
Restore sinuosity in the Big Quilcene River in the historical tidally influenced area	-primarily levee removal -LWD placement -other channel complexity actions	-loss of channel complexity (LWD, channel condition, loss of side channel, channel instability) -estuarine habitat loss and degradation (diking, filling, log storage, road causeways)
Remove dikes on WDFW property on the Big Quilcene River	-lower .5 mile on north shore	-estuarine habitat loss and degradation (diking, filling, log storage, road causeways)
Remove dikes south of the Big Quilcene River to restore salt marsh habitat	-would need to discuss feasibility of this project with private landowners -need to purchase land if landowner willing	-estuarine habitat loss and degradation (diking, filling, log storage, road causeways)
Remove artificially aggraded delta cone at mouth of Big Quilcene River	-excavation is required	-estuarine habitat loss and degradation (diking, filling, log storage, road causeways)
Fish passage at the QNFH weir	-hatchery provides coho fishery and is used for summer chum supplementation -additional habitat could be made available (see Zajac 2002)	-loss of channel complexity (LWD, channel condition, loss of side channel, channel instability) and floodplain loss -loss of habitat

Table 8.11. Little Quilcene River

Recommended Projects/Actions	Tasks involved, sub-actions, barriers to implementation	Limiting factors to address
Restore sinuosity in the Little Quilcene River in the historical tidally influenced area	-primarily levee removal -LWD placement -other channel complexity actions	-loss of channel complexity (LWD, channel condition, loss of side channel, channel instability) and floodplain loss
Remove left bank dike along Little Quilcene River and nearshore	-already owned by county -right bank is private ownership and would need consent and discussions with land owner regarding feasibility	-loss of channel complexity (LWD, channel condition, loss of side channel, channel instability) and floodplain loss -estuarine habitat loss and degradation (diking, filling, log storage, road causeways)
Purchase conservation easement and set back right bank dike along the nearshore associated with the Little Quilcene River to restore salt marsh habitat	-currently in private ownership and would require discussion regarding project feasibility	-estuarine habitat loss and degradation (diking, filling, log storage, road causeways)
Remove artificially aggraded delta cone on Little Quilcene River	-excavation required	-estuarine habitat loss and degradation (diking, filling, log storage, road causeways)

Table 8.12. Quilcene-Dabob Bay

Recommended Projects/Actions	Tasks involved, sub-actions, barriers to implementation	Limiting factors to address
Remove landfill and bulkhead to restore historic saltmarsh and intertidal habitat between Boat Haven Marina and Indian George Creek.	-full residential development is in place and such a project would have to include a buyout the residences -work with landowners to discuss feasibility of project	-estuarine habitat loss and degradation (diking, filling, log storage, road causeways)
Remove abandoned creosoted RR pilings in Quilcene Bay south of Quilcene along W side of Bay		-estuarine habitat loss and degradation (diking, filling, log storage, road causeways)